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GAMMA-RAY SPECTRA OF FRACTIONATED
FISSION PRODUCTS

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ABSTRACT: To determine the effects of fractionation on gamma-ray exposure rates in fission-product fields, spectra of gamma-rays emitted by fractionated products of thermal neutron fission of ^{235}U were studied. Controlled fractionation was brought about by sweeping the rare gas fission products out of sealed samples at 10 to 15 seconds after fission using programmed automatic equipment. Spectra were measured at nine selected times (viz., 1/4, 1/2, 1, 2, 5, 10, 24, 48 and 72 hours) after fission. The detector used was a calibrated and highly collimated 5" x 5" NaI(Tl) crystal. The gamma-ray spectra were unfolded from the pulse-height distributions by means of an iterative method. The number of fissions that had occurred in each sample was determined by radiochemical analysis for ^{99}Mo .

The type and time of fractionation studied in this work is of particular interest in predicting the effects of nuclear explosions, but is also applicable to certain possible nuclear reactor incidents.

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TABLE 5

PHOTON EMISSION RATES OF PRODUCTS
OF THERMAL-NEUTRON FISSION OF ^{235}U

Time After Fission (hr)	Photons/Fission-Sec		Gross ^a Fission Products	Fraction of Gross Fission Products	
	Gaseous Fraction	Solid Fraction		Gaseous ^b Fraction	Solid Fraction
0.25	---	6.2×10^{-4}	8.1×10^{-4}	--	0.77
0.5	---	3.1×10^{-4}	4.3×10^{-4}	--	0.72
1	2.2×10^{-5}	1.5×10^{-4}	2.0×10^{-4}	0.11	0.75
2	6.2×10^{-6}	5.9×10^{-5}	7.9×10^{-5}	0.08	0.75
5	---	1.6×10^{-5}	2.0×10^{-5}	--	0.80
10	---	6.5×10^{-6}	8.1×10^{-6}	--	0.80
24	---	2.6×10^{-6}	3.6×10^{-6}	--	0.72
48	---	1.4×10^{-6}	1.6×10^{-6}	--	0.88
72	---	8.6×10^{-7}	9.4×10^{-7}	--	0.91

^aFrom unfractionated products of thermal-neutron fission given in reference 17.

^bThese values are low due to loss of a portion of the activity in the gas fraction that was deposited in the needle and tubing leading to the trap.

TABLE 6

PHOTON EMISSION RATES OF "FRACTIONATED FALLOUT"
PHOTONS/FISSION - SEC

Time After Fission (hr)	Solid Fraction	Calculated (Moderate Loss of Chains)	Experimental Calculated
1	1.5×10^{-4}	1.0×10^{-4}	1.5
2	5.9×10^{-4}	4.1×10^{-5}	1.2
5	1.6×10^{-5}	1.2×10^{-5}	1.3
24	2.6×10^{-6}	2.9×10^{-6}	0.90
48	1.4×10^{-6}	1.5×10^{-6}	0.93
72	8.6×10^{-7}	9.7×10^{-7}	0.89

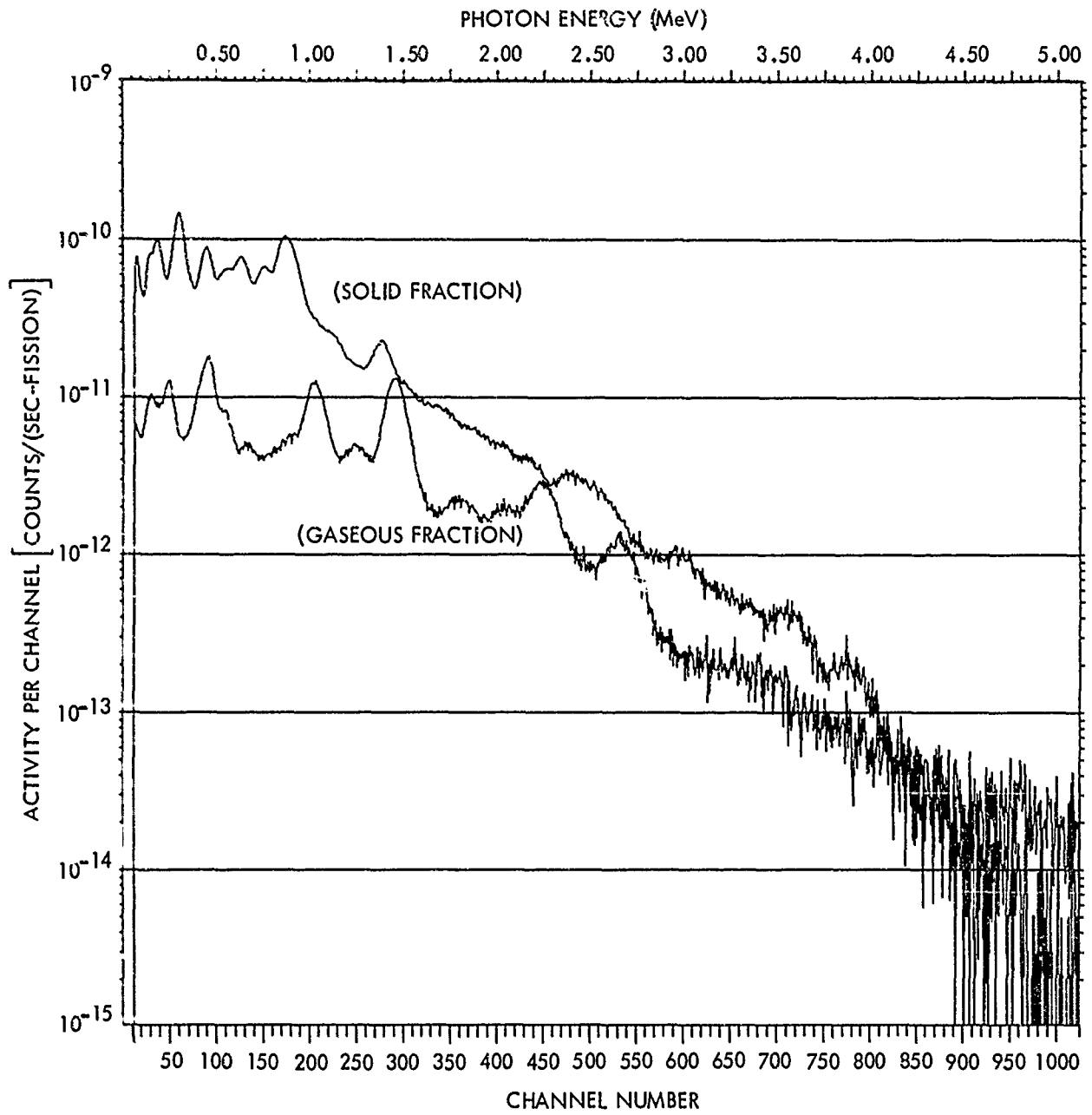


FIG. 3 PULSE-HEIGHT DISTRIBUTIONS OF FRACTIONATED PRODUCTS OF THERMAL-NEUTRON FISSION OF ^{235}U AT 1 HOUR AFTER FISSION.

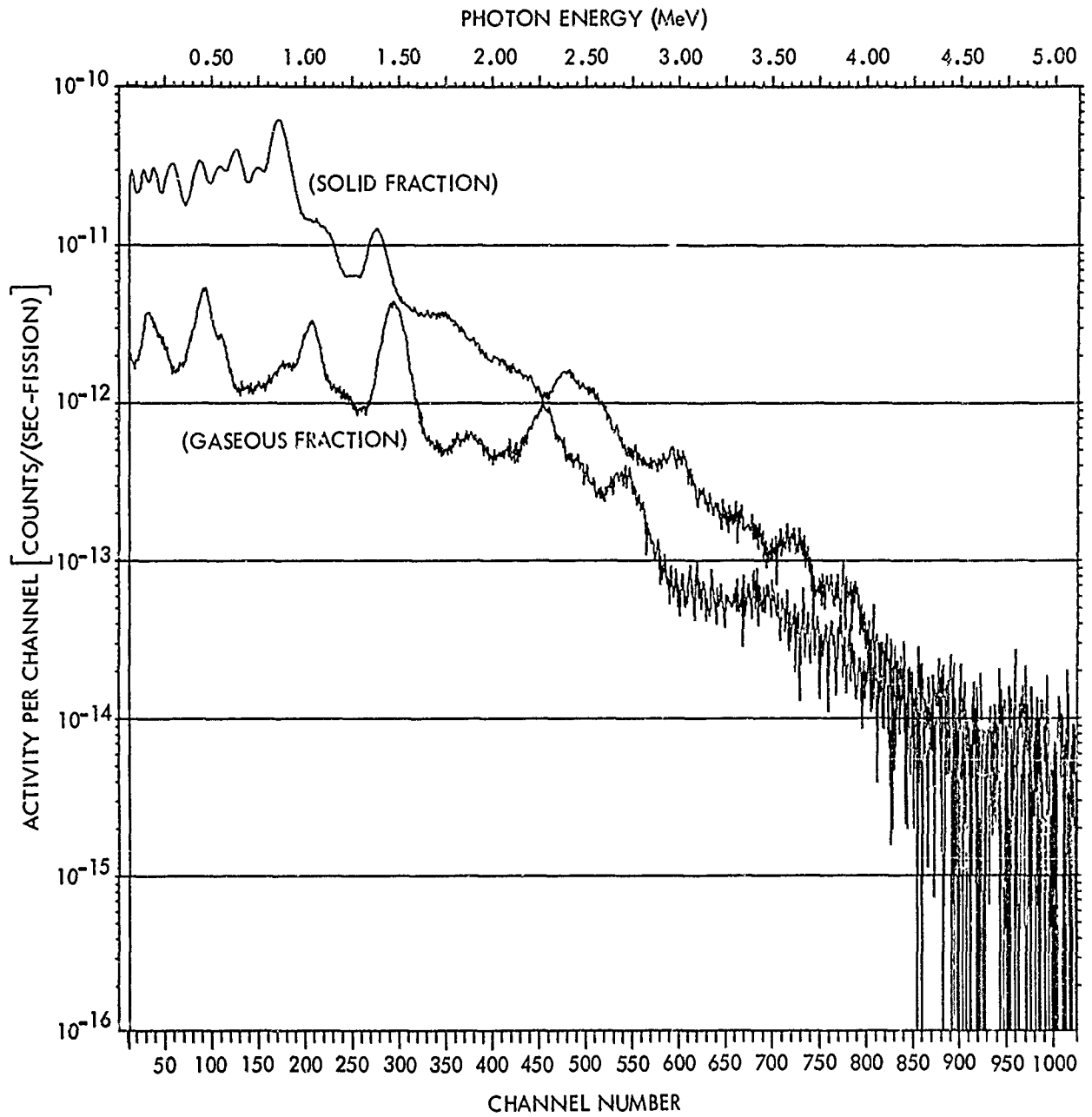


FIG. 4 PULSE-HEIGHT DISTRIBUTIONS OF FRACTIONATED PRODUCTS OF THERMAL-NEUTRON FISSION OF ²³⁵U AT 2 HOURS AFTER FISSION.

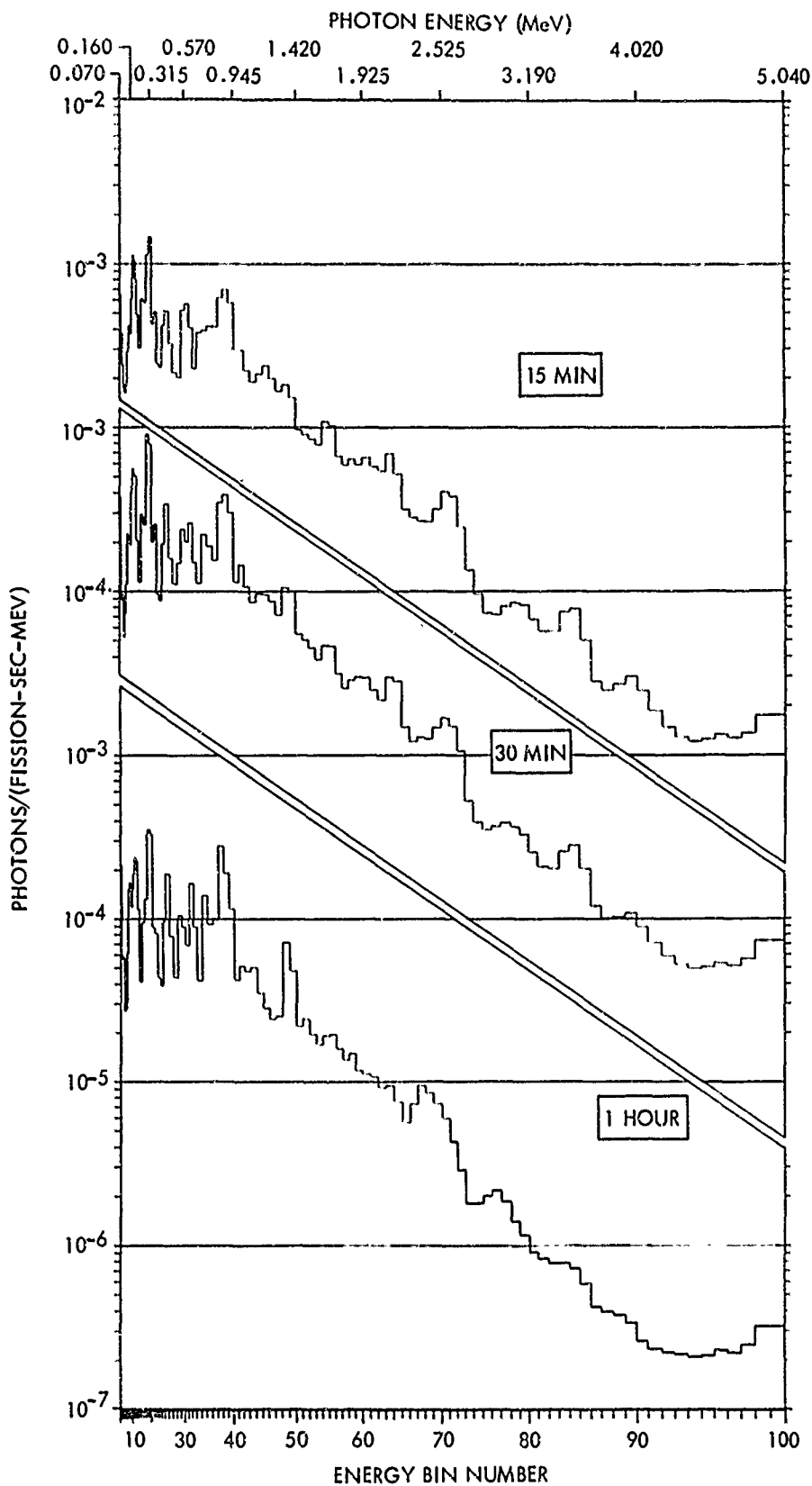


FIG. 5 GAMMA-RAY SPECTRAL-DENSITY HISTOGRAMS OF THE SOLID FRACTIONS FROM PRODUCTS OF THERMAL-NEUTRON FISSION OF ^{235}U AT SELECTED TIMES AFTER FISSION.

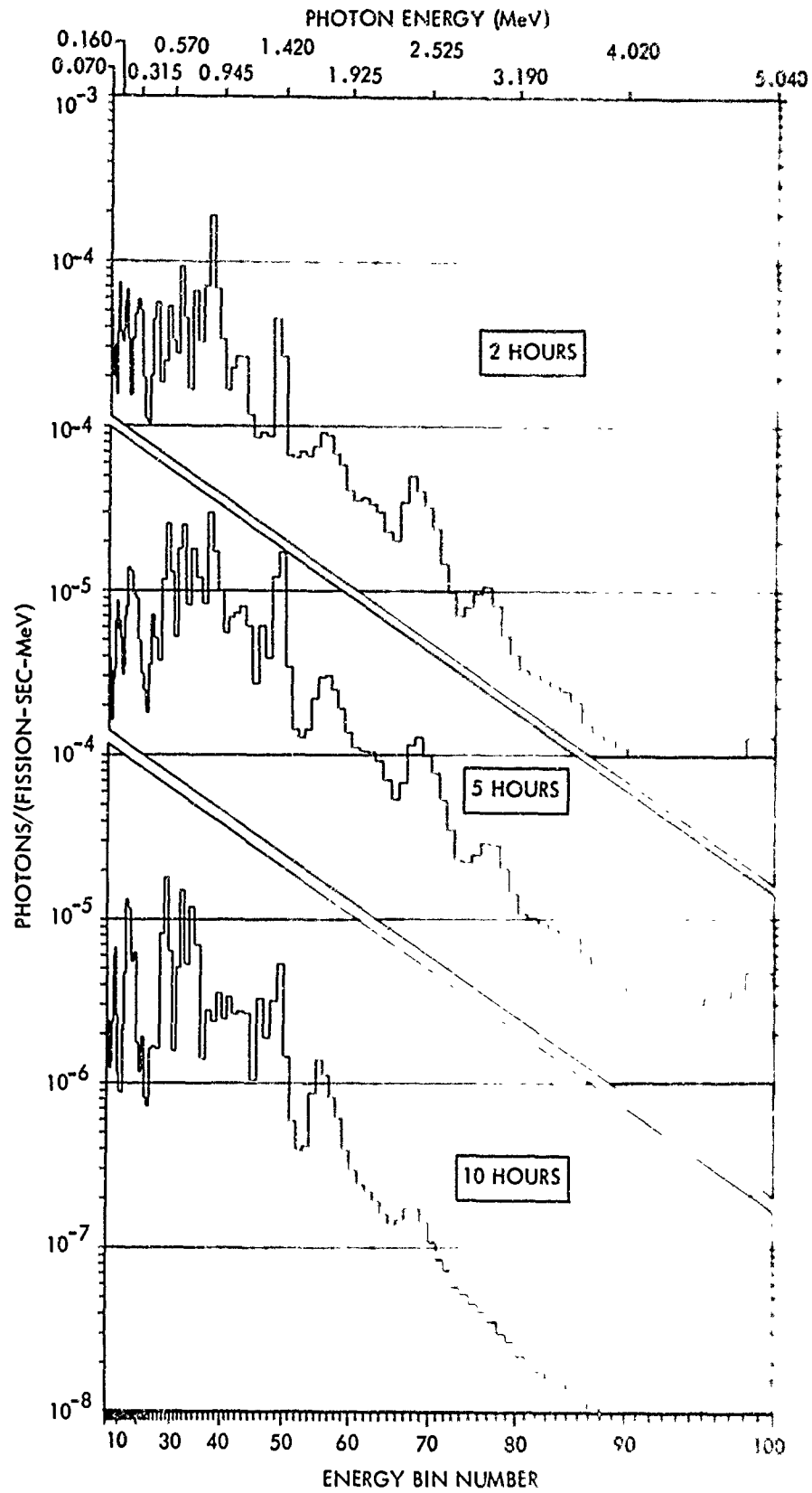


FIG. 6. GAMMA-RAY SPECTRAL-DENSITY HISTOGRAMS OF THE SOLID FRACTIONS FROM PRODUCTS OF THERMAL-NEUTRON FISSION OF ^{235}U AT SELECTED TIMES AFTER FISSION.

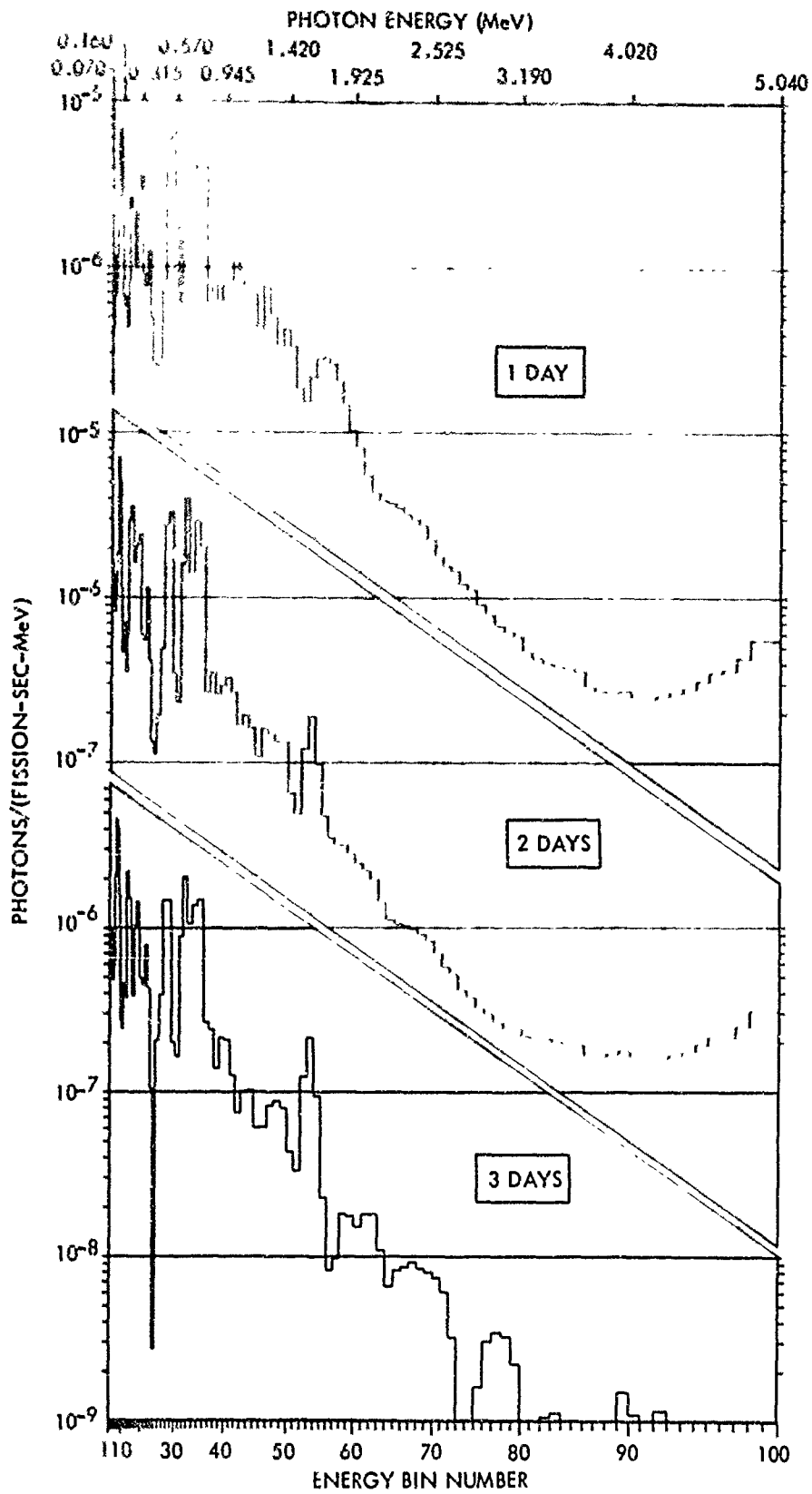


FIG. 7 GAMMA-RAY SPECTRAL-DENSITY HISTOGRAMS OF THE SOLID FRACTIONS FROM PRODUCTS OF THERMAL-NEUTRON FISSION OF ^{235}U AT SELECTED TIMES AFTER FISSION.

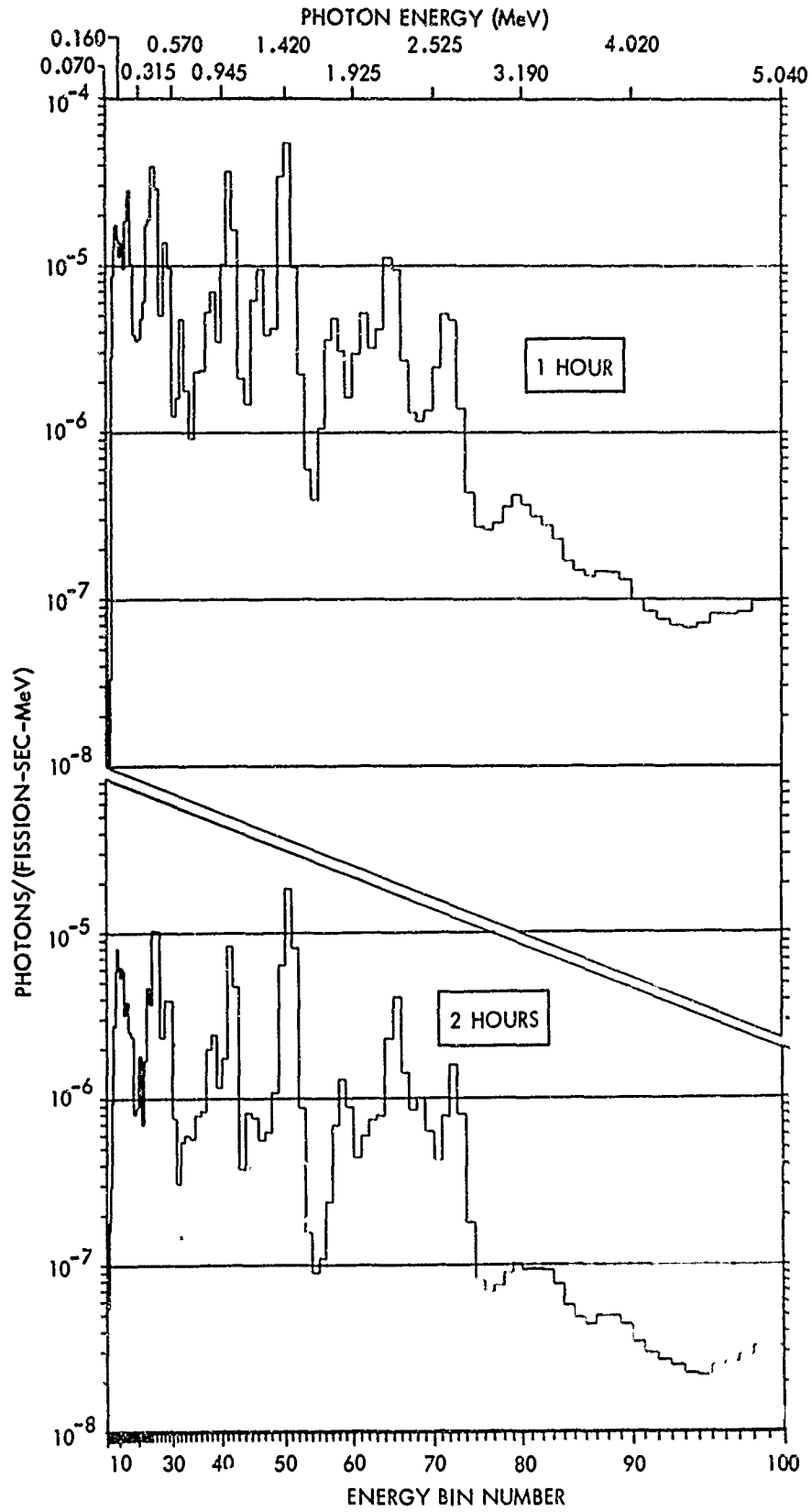


FIG. 8 GAMMA-RAY SPECTRAL-DENSITY HISTOGRAMS OF THE GASEOUS FRACTIONS FROM THERMAL-NEUTRON FISSION OF ^{235}U AT 1 HOUR AND 2 HOURS AFTER FISSION.

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